

FEATURES

- Full-featured evaluation board for the AD7927 device
- Evaluation control board (EVAL-CONTROL-BRD2) compatible
- Standalone capability
- On-board analog buffering and voltage reference
- Various linking options
- PC software for control and data analysis when used with the EVAL-CONTROL-BRD2

GENERAL DESCRIPTION

This document describes the evaluation board used to test the AD7927 ADC. The AD7927 is a high speed 12-bit successive approximation ADC. This part operates from a single 2.7 V to 5 V power supply and features throughput rates of up to 200 kSPS. Refer to the AD7927 data sheet in conjunction with this document.

On-board components for this evaluation board include

- One AD780, which is a pin-programmable 2.5 V or 3 V ultrahigh precision band gap reference
- One REF192 2.5 V reference
- One AD712 dual op amp
- One AD713 quad op amp

Various link options are explained in Table 1.

Interfacing to the evaluation board is through a 96-way connector that is compatible with the evaluation control board (EVAL-CONTROL-BRD2), which is also available from Analog Devices, Inc.

External sockets are provided for REF_{IN} , SCLK, DIN, DOUT, and \overline{CS} signals. In addition, the evaluation board includes two bias-up circuits for bipolar input signals and eight sockets (V_{IN0} to V_{IN7}) for the analog input channels.

FUNCTIONAL BLOCK DIAGRAM

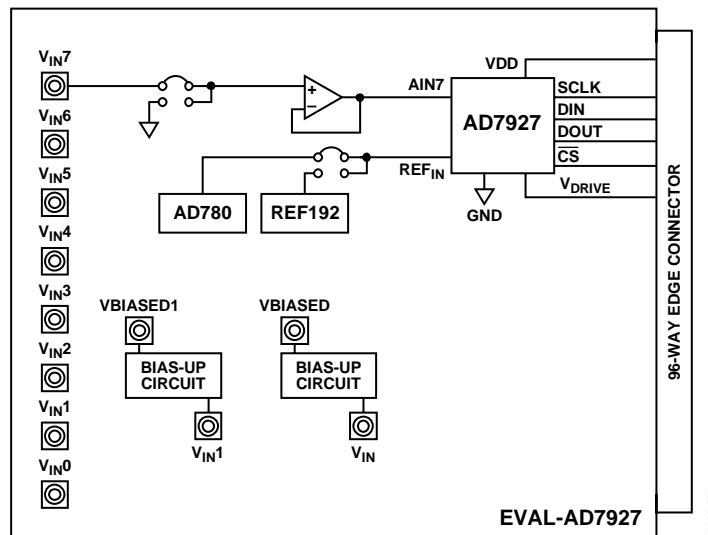


Figure 1.

Rev. 0

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REVISION HISTORY

1/07—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

LINK OPTIONS

There are 28 link options to be set before using the evaluation board. The functions of the options are outlined in Table 1.

Table 1. Link Functions

Link No.	Function
LK1 to LK8	Connects the inputs of the AD713 to the input sockets (V_{IN0} to V_{IN7}) or ties the AD713 inputs to AGND. Position A: Each AD713 input is connected to the relevant input socket. Position B: Each AD713 input is connected to AGND.
LK9	Selects the source of the 12 V supply for the EVAL-AD7927. Position A: The 12 V supply is sourced from the EVAL-CONTROL-BRD2 via the 96-way connector. Position B: The 12 V supply is sourced externally via the J2 connector.
LK10	Selects the source of the -12 V supply for the EVAL-AD7927. Position A: The -12 V supply is sourced from the EVAL-CONTROL-BRD2 via the 96-way connector. Position B: The -12 V supply is sourced externally via the J2 connector.
LK11	Selects the source of the voltage applied to the REF_{IN} pin of the AD7927 and to the bias-up circuits. Position A: The REF192 supplies the 2.5 V reference to the AD7927. Position B: The AD780 supplies the 2.5 V reference to the AD7927.
LK12	Selects the source of the data applied to the DIN pin of the AD7927. Position A: The data is provided from the EVAL-CONTROL-BRD2. Position B: The data is provided from an external source applied via the DIN SMB socket.
LK13	Selects the source of the V_{DD} supply to the AD7927. Position A: The supply voltage is provided from an external source via J5. Position B: The supply voltage is provided from the EVAL-CONTROL-BRD2 via the 96-way connector.
LK14	Selects the source of the \overline{CS} signal for the AD7927. Position A: The \overline{CS} signal is generated by the EVAL-CONTROL-BRD2 via the 96-way connector. Position B: The \overline{CS} signal is applied from an external source via the \overline{CS} SMB socket.
LK15	Connects the data output pin, DOUT, of the AD7927 to the EVAL-CONTROL-BRD2 or to an external SMB socket. Position A: The DOUT pin is connected to the EVAL-CONTROL-BRD2. Position B: The DOUT pin is connected to the external DOUT SMB socket.
LK16	Controls the program pin of the AD780 voltage reference. When this link is inserted, the AD780 output voltage is set to 3.0 V. When this link is removed, the AD780 voltage is set to 2.5 V.
LK17	Selects the source for the SCLK signal applied to the SCLK pin of the AD7927. Position A: SCLK is applied from an external source via the SCLK SMB connector. Position B: SCLK is an inverted signal from the EVAL-CONTROL-BRD2. Position C: SCLK is sourced directly from the EVAL-CONTROL-BRD2.
LK18	Selects the source for the V_{DRIVE} voltage. Position A: V_{DRIVE} is connected to AV_{DD} of the AD7927. Position B: V_{DRIVE} is provided from the EVAL-CONTROL-BRD2 via the 96-way connector. Position C: V_{DRIVE} is provided from an external source via the external J4 connector.
LK19 to LK28	Adds a 51 Ω termination resistor to AGND at the V_{IN0} to V_{IN3} input sockets. When a 51 Ω termination is required, these links should be inserted.

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OPERATING THE EVALUATION BOARD

The evaluation board can be used either as a standalone board or it can be operated in conjunction with the EVAL-CONTROL-BRD2. When operated with the EVAL-CONTROL-BRD2, all supplies and control signals to operate the AD7927 are provided by the EVAL-CONTROL-BRD2. Software to communicate between the control board and the AD7927 is provided with the evaluation board kit. The EVAL-CONTROL-BRD2 operates with all Analog Devices evaluation boards with model numbers ending in the letters CB.

Power Supplies

When using this evaluation board with the EVAL-CONTROL-BRD2, all supplies are provided from the control board through the 96-way connector.

When using the board as a standalone unit, external supplies are required. This evaluation board has seven power supply inputs: EXT_V_{DD}, AGND, +12 V, -12 V, AGND, V_{DRIVE}, and DGND. If the evaluation board is used in standalone mode, a

2.7 V to 5 V supply must be connected to the EXT_V_{DD} input. The +12 V and -12 V supplies are required for the op amps. The V_{DRIVE} input can be connected to a supply from 2.7 V to 5 V, allowing the evaluation board to be connected to both 3 V and 5 V systems. The supplies are decoupled to the ground plane with 10 μ F tantalum and 0.1 μ F multilayer ceramic capacitors at the point to the board. The supply pins of all the op amps, the reference, and the AV_{DD} pins of the AD7927 are decoupled with 10 μ F tantalum and 0.1 μ F ceramic capacitors.

INITIAL SETUP CONDITIONS

Before applying power or signals to the evaluation board, care should be taken to ensure that all link positions are as per the required operating mode. Failure to do this may result in damage to the evaluation board.

Table 2 outlines the default positions of all links when the board is shipped. The links are set so that all power supplies and control signals are supplied by the EVAL-CONTROL-BRD2.

Table 2. Initial Link Positions

Link No.	Position	Function
LK1	A	Input of AD713 is connected to the V _{IN0} SMB socket.
LK2 to LK8	B	AD713 inputs are connected to GND.
LK9	A	The +12 V supply is generated by EVAL-CONTROL-BRD2.
LK10	A	The -12 V supply is generated by EVAL-CONTROL-BRD2.
LK11	B	The AD780 supplies the 2.5 V reference to the AD7927.
LK12	A	Data applied to the DIN pin of the AD7927 is generated by EVAL-CONTROL-BRD2.
LK13	B	V _{DD} is supplied from EVAL-CONTROL-BRD2.
LK14	A	The \overline{CS} signal is generated by EVAL-CONTROL-BRD2.
LK15	A	The DOUT pin is connected to EVAL-CONTROL-BRD2.
LK16	OUT	The AD780 voltage is set to 2.5 V.
LK17	C	The SCLK signal is sourced directly from EVAL-CONTROL-BRD2.
LK18	B	V _{DRIVE} is generated by EVAL-CONTROL-BRD2.
LK19 to LK28	OUT	A 51 Ω termination on the inputs is not added.

INTERFACING THE EVALUATION BOARD

Interfacing the evaluation board to the EVAL-CONTROL-BRD2 or another system is accomplished via a 96-way connector, J1. Plug the 96-way connector of the evaluation board directly into the 96-way connector of the EVAL-CONTROL-BRD2.

The 96-way connector is powered from a 12 V ac transformer. Suitable transformers, including the following, are available from Analog Devices as accessories:

- EVAL-110VAC-US: for use in the U.S. or Japan
- EVAL-220VAC-UK: for use in the U.K.
- EVAL-220VAC-EU: for use in Europe

Other suppliers also offer compatible transformers, including Digi-Key Corporation (U.S.) and Campbell Collins, Ltd. (U.K.).

Connection between the EVAL-CONTROL-BRD2 and the parallel port of a PC is via a standard Centronics, Inc., printer port cable, which is provided as part of the EVAL-CONTROL-BRD2 package. Refer to the manual that accompanies this package for more details.

Figure 2 shows the pinout for the 96-way connector, and Table 3 and Table 4 list the pin descriptions and designators.

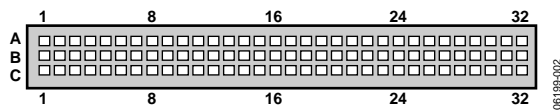


Figure 2. Pin Configuration for the 96-Way Connector, J1

Table 3.

Pin	Description
DR	Data Receive. Serial data from the device is provided at this output. Sixteen bits of data are provided with a leading zero, three channel address bits, followed by twelve bits of conversion data provided MSB first.
DT	Data Transmit. Serial data from the DSP is provided at this pin. Twelve bits of data are provided, which are provided MSB first.
SCLK	Serial Clock Zero. This continuous clock is connected to the SCLK pin of the AD7927 via LK17 to obtain serial data from the device.
TFS0	Transmit Frame Sync Zero.
RFS0	Receive Frame Sync Zero. Both the TRS0 and RFS0 inputs are connected to the AD7927 CS pin to initiate conversions and frame the serial data transfer.
DGND	Digital Ground. These lines are connected to the digital ground plane of the evaluation board and allow you to provide the digital supply via the connector and the other digital signals.
AGND	Analog Ground. These lines are connected to the analog ground plane of the evaluation board.
AV _{DD}	Analog +5 V Supply. These lines are connected to the AV _{DD} supply line of the evaluation board via LK13.
+12 V	+12 V Supply. This line is connected to the +12 V supply line of the evaluation board via LK9.
-12 V	-12 V Supply. This line is connected to the -12 V supply line of the evaluation board via LK10.

Table 4. 96-Way Connector Pin Functions¹

Pin No.	Row A	Row B	Row C
1			
2			
3			
4	DGND	DGND	DGND
5	DT0		DR0
6	TFS0		RFS0
7	SCLK0		SCLK0
8			
9			
10			
11			
12	DGND	DGND	DGND
13			
14			
15			
16	DGND	DGND	DGND
17			
18			
19			
20	DGND	DGND	DGND
21	AGND	AGND	AGND
22	AGND	AGND	AGND
23	AGND	AGND	AGND
24	AGND	AGND	AGND
25	AGND	AGND	AGND
26	AGND	AGND	AGND
27		AGND	
28		AGND	
29	AGND	AGND	AGND
30	-12 V	AGND	+12 V
31			
32	AV _{DD}	AV _{DD}	AV _{DD}

¹ The unused pins of the 96-way connector are not shown.

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SOCKETS

There are 20 input/output sockets relevant to the operation of the AD7927 with this evaluation board. The functions of these sockets are outlined in Table 5.

Table 5. Socket Functions

Socket	Function
J1	96-way connector for serial interface and power supply connections.
J2	External +12 V, -12 V, and AGND power connector.
J3	External V_{DRIVE} connector.
J4	Subminiature BNC socket for bipolar input signal to Bias-Up Circuit 0.
J5	External V_{DD} and AGND power connector.
J6	Subminiature BNC socket for output from Bias-Up Circuit 0. Unipolar signal.
J7	Subminiature BNC socket for bipolar input signal to Bias-Up Circuit 1.
J8	Subminiature BNC socket for output from Bias-Up Circuit 1. Unipolar signal.
V_{IN0} to V_{IN7}	Subminiature BNC sockets for analog input Channels 0 to 7.
REF_{IN}	Subminiature BNC socket for REF_{IN} voltage.
$SCLK$	Subminiature BNC socket for external $SCLK$.
\overline{CS}	Subminiature BNC socket for external \overline{CS} .
DIN	Subminiature BNC socket for external DIN.
DOUT	Subminiature BNC socket for DOUT signal.

EVALUATION BOARD SOFTWARE

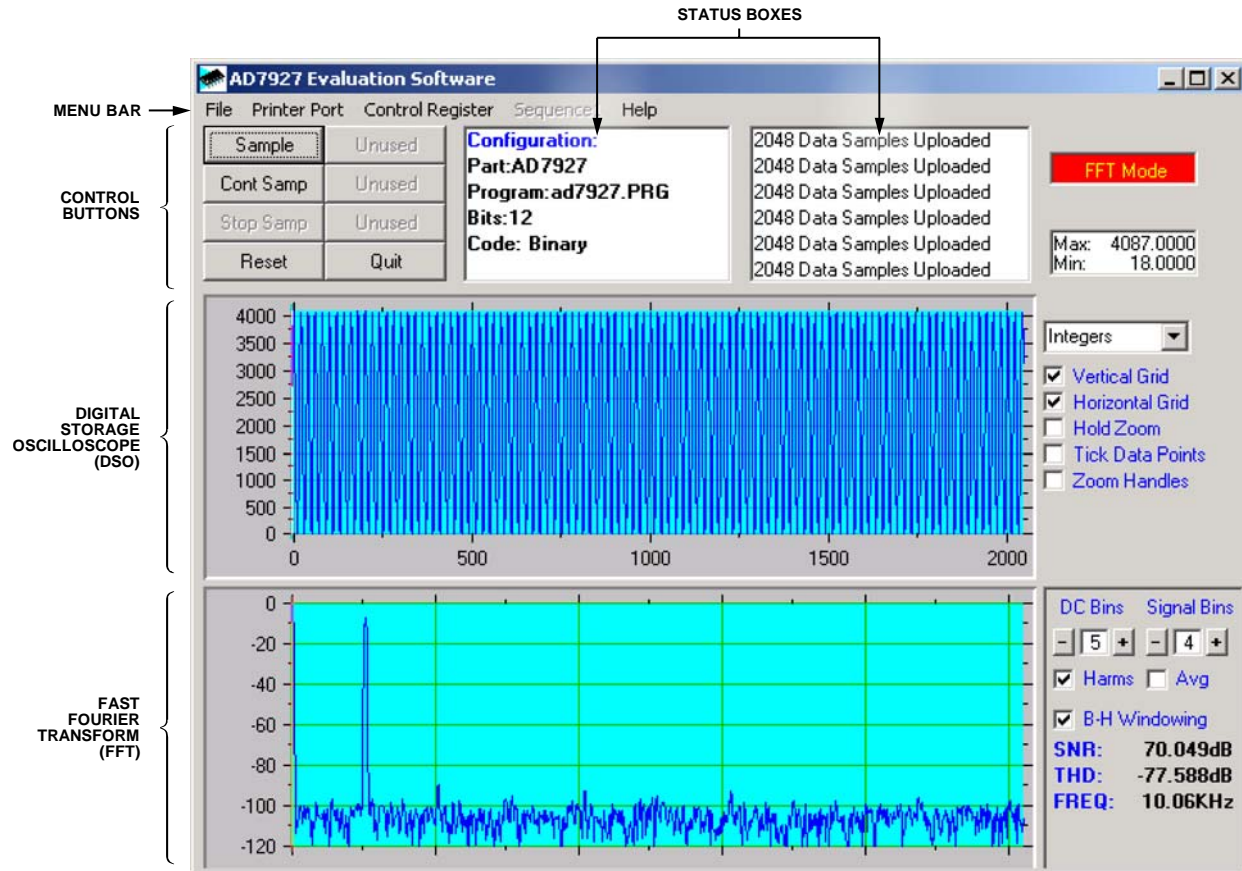


Figure 3. Main Dialog Box

INSTALLING THE SOFTWARE

The EVAL-AD7927 kit includes a CD-ROM.

When the CD is inserted into the PC, an installation program automatically begins. This program installs the evaluation software.

THE MAIN DIALOG BOX

The software that controls the EVAL-CONTROL-BRD2 and therefore the AD7927 evaluation board consists of three dialog boxes. The main dialog box—the **AD7927 Evaluation Software** dialog box, shown in Figure 3, allows you to read a predetermined number of samples from the evaluation board and display the samples in both the time and frequency domain. This dialog box can be divided into three sections.

The top section of the dialog box contains the control buttons, the menu bar, and the status boxes.

Control Buttons

Use the control buttons to sample data (**Sample**), reset the board (**Reset**), and retrieve information about the software.

Click **Reset** to cause the EVAL-CONTROL-BRD2 to perform a reset. During a reset, the power supply to the evaluation board is turned off, and the program in the DSP memory is lost. If required, set up the board again to download another program. Click **Quit** to

exit the software. Note, however, that this will not terminate the program running on the EVAL-CONTROL-BRD2.

Menu Bar

The menu bar consists of the **File**, **Printer Port**, **Control Register**, **Sequence**, and **Help** drop-down menus.

The **File** drop-down menu offers the following selections:

- **Setup Menu.** Select this option to display the **Setup Menu** dialog box, as shown in Figure 5.
- **Load Raw Data.** Select this option to load data saved by the software during a previous session.
- **Save Raw Data.** Select this option to save the current set of sample data points. The data can be reloaded to the evaluation software later or can be used by other programs for analysis.
- **Save Binary Data.** Select this option to save the current set of sample data points. The data is saved in binary format as a text file. This method can be useful for examining code flicker and identifying stuck bits, that is, bits that are not changing.
- **Save FFT Data.** Select this option to save the current set of FFT data points. FFT data cannot be reloaded into the EVAL-CONTROL BRD2 software, but can be loaded into other software packages for further analysis.
- **Exit.** Quits the program.

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The **Printer Port** drop-down menu allows you to select the printer port used to communicate with the EVAL-CONTROL BRD2.

- **LPT1**. This option selects 0x378 as the printer port base address. This is the default option.
- **LPT2**. This option selects 0x278 as the printer port base address.
- **PRN**. This option selects 0x3BC as the printer port base address.

Set up the operating conditions for the device using the **Control Register** drop-down menu. After you select the conditions, a 12-bit word is sent to the AD7927 control register on the next serial transfer.

The **Sequence** menu is inactive in this version of software.

The **Help** drop-down menu provides information about the current version of software for the evaluation board.

Status Boxes

The status boxes display the setup of the evaluation board, the number of samples taken, and any messages generated.

Oscilloscope

The middle section of the main dialog box is a digital storage oscilloscope (DSO). It can display samples uploaded from the EVAL-CONTROL-BRD2. Samples can be displayed as integer

values or as voltages. After samples are displayed, click any point in the graph to display the sample number and value of that point. Along the axis of the graph are sizing handles that allow you to zoom in for a closer look of a sample, if required. When another set of samples is taken, the graph attempts to display all values collected unless the **Hold Zoom** check box is selected. If **Hold Zoom** is selected, the graph retains the same axis settings as the previous set of data samples. Additional check boxes are provided so that you can control the vertical and horizontal grids and the data points.

Fast Fourier Transform/Histogram

The lower section of the main dialog box can display a fast Fourier transform (FFT) of the data or a histogram, which shows the number of occurrences of each code readback. The FFT (default option) is typically used for assessing an ADC's performance in the frequency domain, whereas the histogram is used to assess the ADC's performance with dc signals. The option displayed can be switched by clicking **FFT Mode/Histogram Mode** at the upper right of the dialog box. Figure 4 shows the main dialog box when the **Histogram Mode** option is selected.

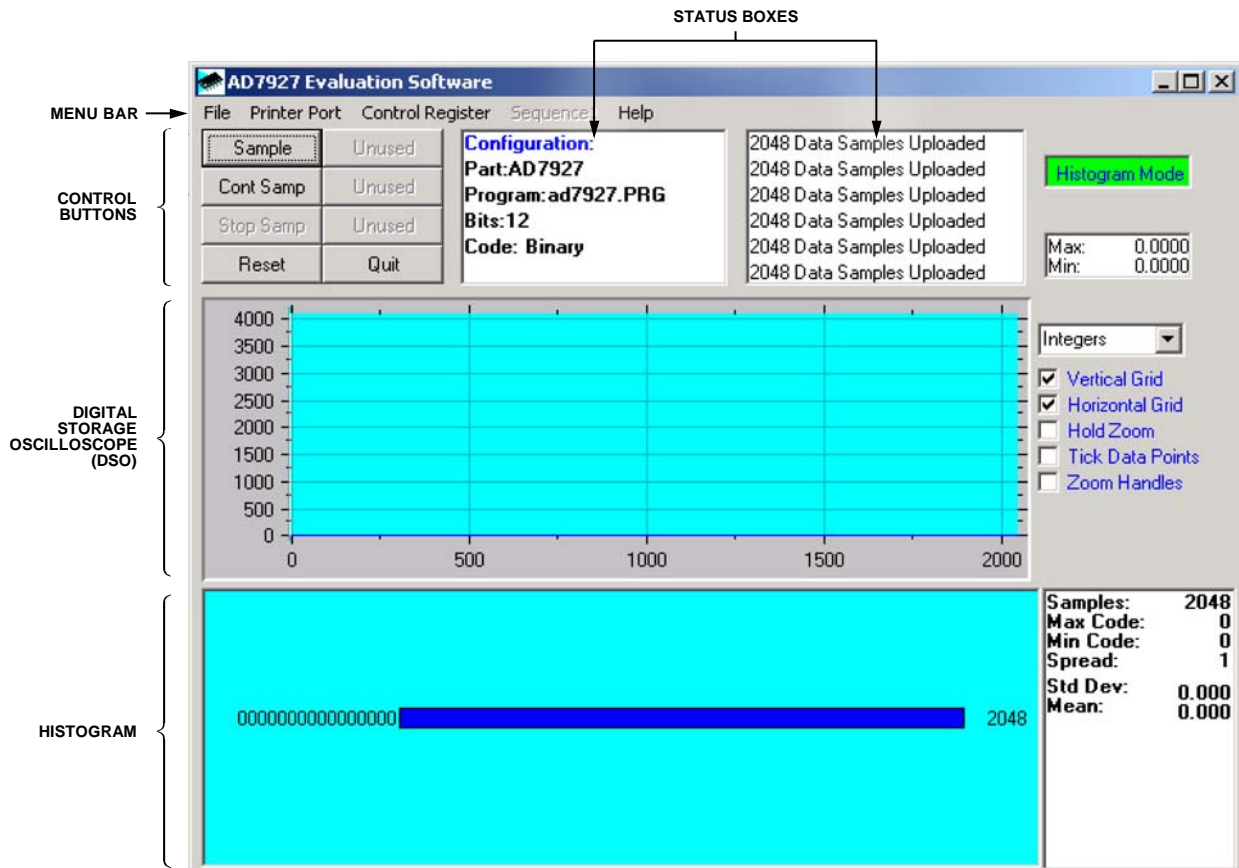


Figure 4. Main Dialog Box, Histogram Mode

SETUP MENU

The **Setup Menu**, shown in Figure 5, allows you to load the required configuration file for the evaluation board. When the configuration file is loaded, the software acquires detailed information about the evaluation board and the ADC connected to EVAL-CONTROL-BRD2. This includes information such as the number of bits, maximum sampling rate, type of output coding, maximum analog input, and power supply requirements.

The configuration file also indicates to the software the name of the DSP program file to download to the EVAL-CONTROL-BRD2. The **Setup Menu** allows you to choose the sampling frequency and the number of samples.

CHECKING THE EVAL-CONTROL-BRD2

The EVAL-CONTROL-BRD2 and the evaluation board should be connected together as described in the Interfacing the Evaluation Board section.

At this stage, the red LED on the EVAL-CONTROL-BRD2 should be flashing. This indicates that the EVAL-CONTROL-BRD2 is functional and ready to receive instructions.

Note that the software should be installed before the printer port cable is connected between the EVAL-CONTROL-BRD2 and the PC. This ensures that the printer port has been initialized correctly.

USING THE SOFTWARE

After the hardware and software is set up

1. From the **File** menu, select **Setup Menu**.

A setup form displays. A list box on the **Setup Menu** lists the available configuration files. The configuration files are text-based files containing information about the ADC to be tested (**AD7927.cfg**).

2. Select the relevant configuration file and click **Load**.

The EVAL-CONTROL-BRD2 is reset, and the DSP program is downloaded. After the download is complete, the power supply settings indicated in the configuration file are set and you may hear some of the relays clicking. The drop-down list boxes, **Select No. Of Samples** and **Select Sample Frequency**, are set to the default values specified in the configuration file. Note that you can change these settings at any point.

3. After all the settings are set, click **Close** to return to the main dialog box.

Default Conditions

The EVAL-AD7927 is configured to convert on Channel 0 in normal mode with straight binary output coding and a 0 to REF_{IN} input range. If no changes are made to the control register via the **Control Register** drop-down menu on the main dialog box, clicking **Sample** yields conversion results from Channel 0.

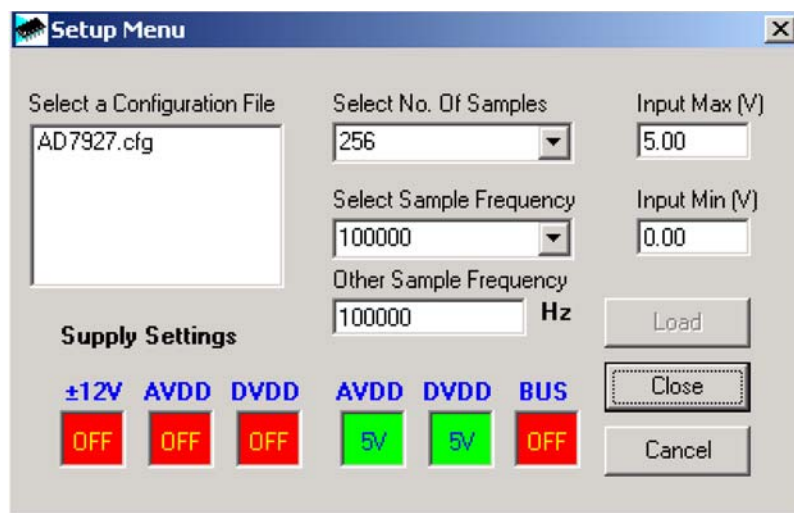


Figure 5. Setup Menu Dialog Box

Taking Samples

To instruct the EVAL-CONTROL BRD2 to obtain the required number of samples at the required frequency, follow these steps using the main dialog box, shown in Figure 3:

1. Click **Sample**.
Select a sampling frequency up to the rate of 200 kSPS. Samples are uploaded and displayed. An FFT and histogram are also calculated and displayed.
2. Click **Cont Sample** to continue taking samples.
To stop sampling, click **Cont Sample** again. Note that while the software is continuously sampling data, the other control buttons are disabled.
3. Click **Exit** to stop the process.

Software Configuration Files

Software configuration files provide the EVAL-CONTROL-BRD2 software with information on how the software and hardware should perform. These files contain information, such as the name of the DSP program to download, the default and maximum sampling frequencies, the number of samples to take, and the power supply settings to use.

What follows is a typical software configuration file (*.cfg).

```
[EVAL-CONTROL BOARD]
partname:AD7927
programname:ad7927.PRG
samplefrequency:100000
maxsamplefrequency:200000
samples:2048
```

```
+/-15V:on
dvdd:5:on
avdd:5:on
bus:on
;options 2scomp, binary
dataformat:binary
numberofbits:12
inputVmax:2.5
inputVmin:0
[endofconfig]
```

Sequencer Modes: FFT Mode and Histogram Mode

FFT Mode

To operate the EVAL-AD7927 in FFT mode with the sequence and shadow bits set to 11 in the **Control Register** drop-down menu, follow these steps:

1. Select the 11 combination from the **Shadow/Seq** bits in the **Control Register** drop-down menu.
2. Select the final channel in the sequence.
3. After the control register configuration is set, click **Sample**.

When the evaluation board is finished taking samples on the selected channels in the sequence, the resulting FFTs are displayed in the lower section of the main dialog box. **SNR:**, **THD:**, and **FREQ:** show results that correspond to the final channel in the programmed sequence.

If individual SNR, THD, and frequency results are required from each individual channel, operate the device in normal mode with the sequence and shadow (**Shadow/Seq**) bits set to 00 and select the individual channel in the **Control Register** drop-down menu.

Histogram Mode

When operating the evaluation board in histogram mode with the sequence and shadow bits set to 11 in the **Control Register** drop-down menu, follow these steps:

1. Select the 11 combination for the **Shadow/Seq** bits in the **Control Register** drop-down menu.
2. Select the final channel in the sequence.
3. After the control register configuration is set, select **Sample**.

When the evaluation board is finished taking samples on the selected channels in the sequence, the resulting histogram displays in the lower portion of the main dialog box. The histogram corresponds to the first channel in the programmed sequence. **Max Code:**, **Min Code:**, **Spread:**, **Std Dev:**, and **Mean:** show results that correspond to the first channel in the programmed sequence.

If you want the codes, such as the maximum code and the minimum code, to correspond to a particular channel, operate the ADC in normal mode with the sequence and shadow (**Shadow/Seq**) bits set to 00 and select the individual channel in the **Control Register** drop-down menu.

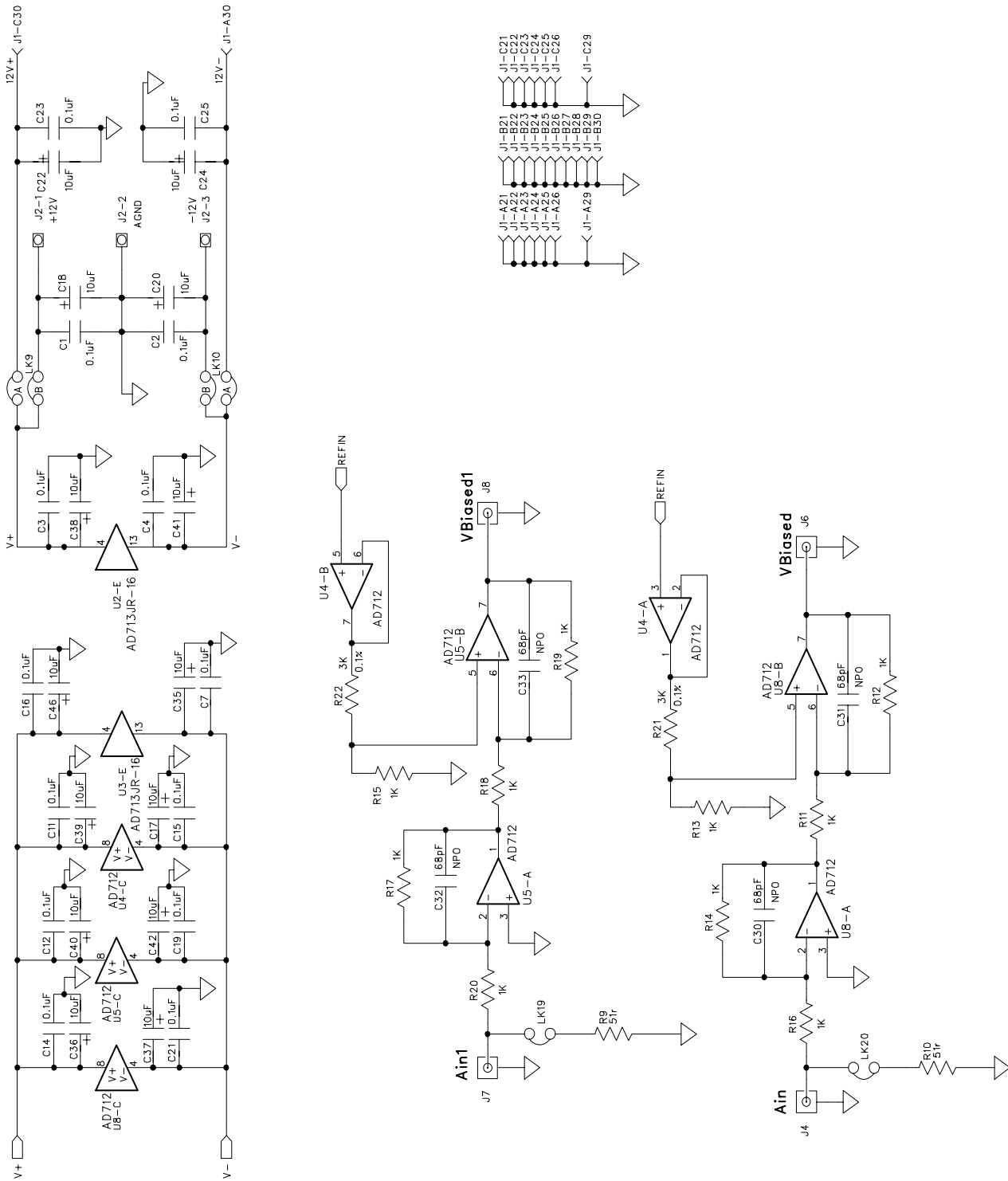


Figure 7. Schematic 2

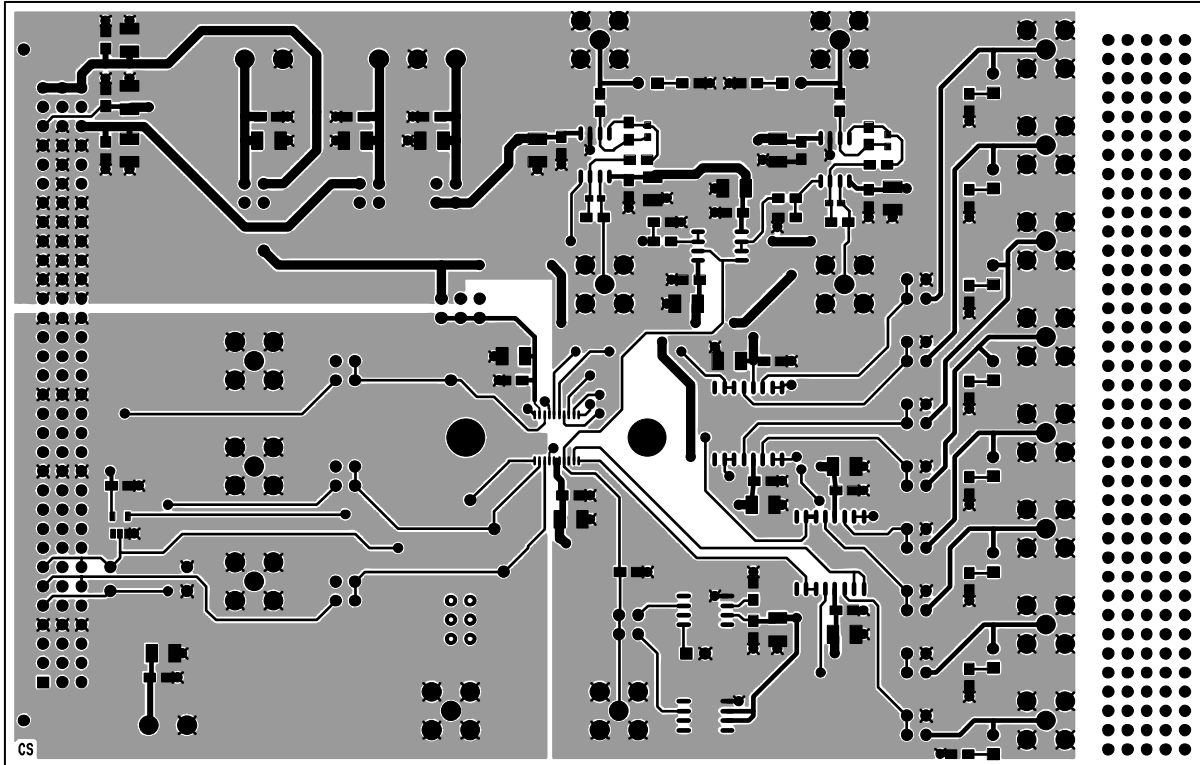


Figure 8. Component Side Artwork

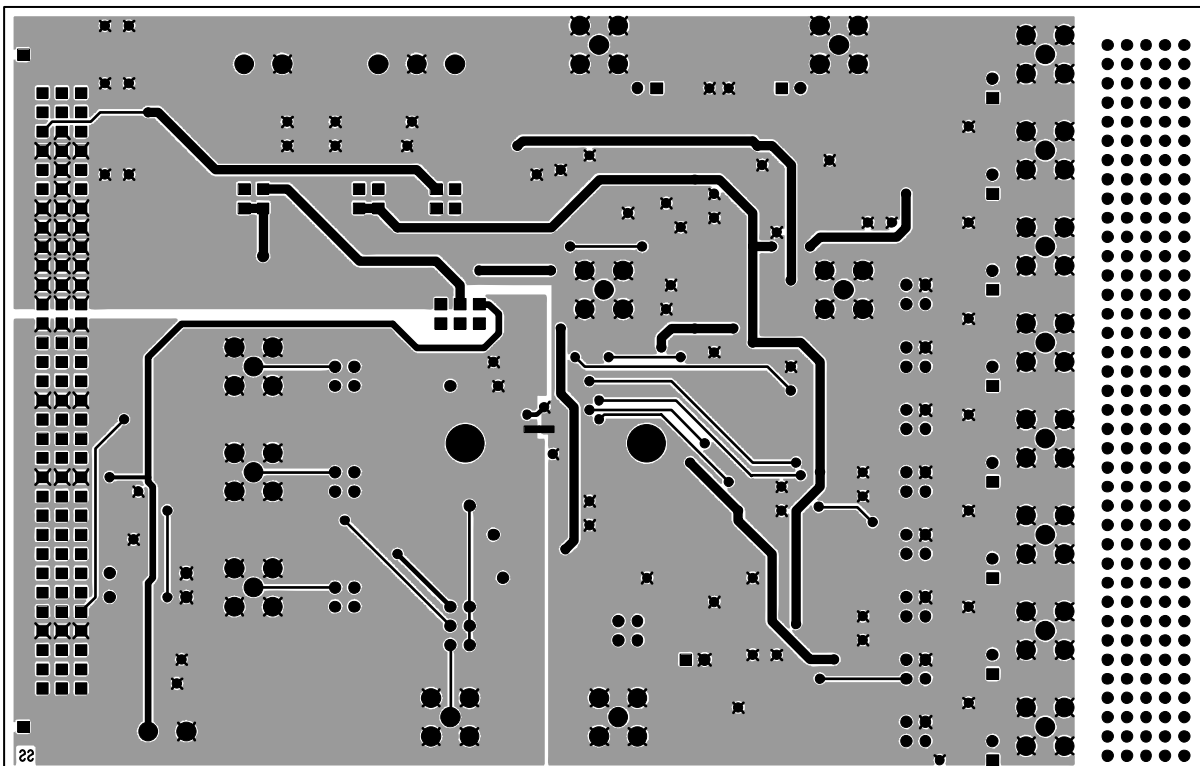


Figure 9. Solder Side Artwork

EVAL-AD7927

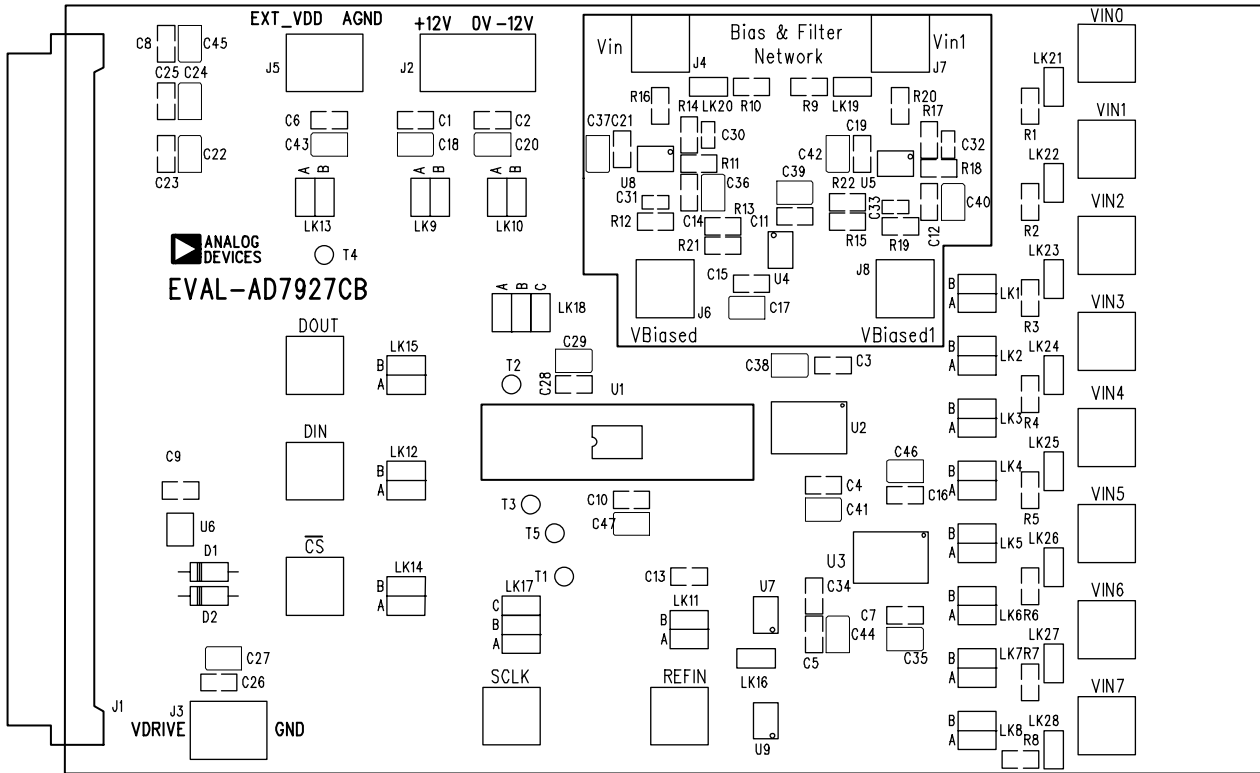


Figure 10. Component Placement Drawing

ORDERING INFORMATION

BILL OF MATERIALS

Table 6. Components Listing

Qty	Reference Designator	Part Type/Description	PCB Decal	Supplier No. ¹
1	U1	8-channel, 200 kSPS, 12-bit ADC with sequencer	TSSOP-16	Analog Devices AD7927
2	U2, U3	Quad precision, low cost, high speed BiFET op amps	SOIC16NB	Analog Devices AD713
3	U4, U5, U8	Dual precision, low cost, high speed BiFET op amps	SOIC8NB	Analog Devices AD712
1	U6	Tiny logic high speed inverter	SOT23-5	FEC 685-914
1	U7	2.5 V/3.0 V ultrahigh precision band gap voltage reference	SOIC8NB	Analog Devices AD780
1	U9	Precision micropower, low dropout, low voltage reference	SOIC8NB	Analog Devices REF192
10	R1 to R10	51 Ω resistors	805	FEC 321-7905
10	R11 to R20	1 k Ω resistors	805	FEC 911-859
2	R21, R22	3 k Ω resistors	805	FEC 321-8119
21	C1 to C12, C14 to C16, C19, C21, C23, C25, C26, C28	0.1 μ F capacitors	805	FEC 499-687
20	C17, C18, C20, C22, C24, C27, C29, C35 to C47	10 μ F tantalum capacitors	CAP\TAJ_B	FEC 197-427
1	C13	1 μ F capacitor	805	FEC 317-640
4	C30 to C33	68 pF capacitors	603	FEC 722-066
1	C34	10 nF capacitor	805	FEC 499-225
2	D1, D2	Schottky diode	DO35	Vishay SD103C
17	DIN, CS, DOUT, J4, J6, J7, J8, REFIN, SCLK, VIN0 to VIN7	50 Ω gold-plated PCB SMB jacks	SMB	FEC 310-682
1	J1	CON\41612\96	DIN41612-96	FEC 104-986
1	J2	3-pin power connector	CON\POWER3	FEC 151-786
2	J3, J5	2-pin power connectors	CON\POWER	FEC 151-785
15	LK1 to LK15	4-pin headers (2 \times 2)	Headers	FEC 511-791
1	LK16	Jumper	SIP-2P	FEC 511-705
10	LK19 to LK28	Jumpers	SIP-2P	FEC 511-705
2	LK17, LK18	6-pin headers (2 \times 3)	Headers	FEC 511-780
14	LK1 to LK14	Shorting links		FEC 528-456
5	T1 to T5	Testpoints	Testpoints	FEC 240-333
1	X1	Clamp-SOIC-TSSOP	Clamp	
4	Each corner	Stick-on feet	3M	FEC 651-813

¹ FEC = Farnell Electronic Components®.

EVAL-AD7927

ORDERING GUIDE

Model	Description
EVAL-AD7927CB	AD7927 Evaluation Board

ESD CAUTION



ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.